ANCHOR QEA

integral consulting inc

614 Magnolia Avenue
Ocean Springs, Mississippi 39564
Phone 228.818.9626
Fax 228.818.9631

DRAFT MEMORANDUM

To:	Gary Miller U.S. Environmental Protection Agency	**Date:**	March 23, 2016
From:	Jennifer Sampson, Integral Consulting Inc. David Keith, Anchor QEA, LLC		
Cc:	Dave Moreira, McGinnes Industrial Maintenance Corporation Philip Slowiak, International Paper Company		
Re:	Draft Addendum 2 to the Tissue Sampling and Analysis Plan (SAP) for Additional Gulf Killifish Tissue Sampling, San Jacinto River Waste Pits Superfund Site		

INTRODUCTION

This draft memorandum is an Addendum to the Sampling and Analysis Plan (SAP) for the Tissue Study at the San Jacinto River Waste Pits (SJRWP) Superfund site (Site) (Integral 2010a), and is submitted on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC) (collectively referred to as Respondents), pursuant to the requirements of Unilateral Administrative Order (UAO), Docket No. 06-03-10, issued on November 20, 2009 (USEPA 2009a). The UAO requires Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site.

Concurrent with the RI/FS, the time critical removal action (TCRA) was implemented by IPC and MIMC under an Administrative Order on Consent with the U.S. Environmental Protection Agency (USEPA) (Docket No. 06-12-10; USEPA 2010). The TCRA program involved capping and isolation of the wastes in the impoundments north of I-10, with related construction completed in July 2011. The purpose of the TCRA was to stabilize the entire area within the original 1966 perimeter of the impoundments north of I-10 (the TCRA Site), until a final remedy is implemented (USEPA 2010).

This draft Addendum to the Tissue SAP (Integral 2010a) was prepared in response to requirements described by USEPA in a teleconference meeting with Respondents on

March 4, 2016. In this meeting, USEPA required that Respondents collect tissue samples for consideration, along with several other lines of evidence, in evaluating of the effectiveness of the TCRA cap to contain the wastes in the impoundments north of I-10. That meeting provides the basis for the Data Quality Objectives (DQOs) for additional tissue sampling, specified below.

In addition to addressing the DQOs for additional tissue sampling, this draft Addendum provides for all quality assurance and quality control (QA/QC) procedures that will be applied during tissue sampling, analysis, data validation, and reporting. As an Addendum to the Tissue SAP, this document describes a sampling effort to be conducted in full compliance with the approved Tissue SAP (Integral 2010a). Only those aspects unique to the additional tissue sampling to be conducted in spring 2016 are addressed by this document.

CONCEPTUAL SITE MODEL

The detailed discussion of the conceptual site model (CSM) in the Remedial Investigation Report (RI Report; Integral and Anchor QEA 2013) addresses the physical and chemical elements of the CSM: the sources, releases, and transport mechanisms of chemicals of concern (COCs), and the complete and significant exposure pathways to potential ecological and human receptors. This document incorporates that discussion by reference. It also incorporates observations highlighted in the discussion of the CSM presented in Sediment SAP Addendum 3 (Integral and Anchor QEA 2016) that are relevant to the spatial extent and distribution of COCs in sediment attributed to the northern impoundments under baseline conditions. The updated CSM is illustrated in Figure 1.

The uncertainty related to the effects of barging operations ongoing in the area adjacent to the impoundments north of I-10 on the CSM, described in Sediment SAP Addendum 3, also affects interpretation of the results of the tissue sampling described by this SAP Addendum. Because barging operations have been redistributing sediments that surround the northern impoundments for more than 4 years, any differences between the 2010 baseline surface sediment chemistry and sediment chemistry in 2015 may be at least partly attributable to the redistribution resulting from propeller wash (Figure 1). To the extent that dioxins and furans in sediments and in suspended sediments are a driver of dioxins and furans in tissue of the target biota, the uncertainty described for the sediment study is a factor for the

interpretation of tissue data. Under these circumstances, concentrations of dioxins and furans in tissue in 2016 that are above concentrations in 2010 may be attributable to the effect of propeller wash, and not necessarily the result of ineffectiveness of the TCRA cap.

ANALYSIS OF EXISTING INFORMATION

In addition to consideration of the recently updated CSM and related uncertainties, the 2016 fish tissue study was designed in the context of substantial information presented in the RI Report on the bioaccumulation of dioxins and furans, both generally and as it has been documented using data for the environment within USEPA's preliminary Site perimeter under baseline (pre-TCRA).

Bioaccumulation of Dioxins and Furans

Bioaccumulation of dioxins and furans has been evaluated in depth for this Remedial Investigation, and has included the following lines of evidence: collection of site-specific data for sediment and tissue; evaluation of regional data for sediment, water and tissue generated by the Texas Commission on Environmental Quality; and review and synthesis of literature on bioaccumulation and metabolism of dioxins and furans by fish and invertebrates. These evaluations are presented in detail in the Technical Memorandum on Bioaccumulation Modeling (Integral 2010b) and the RI Report (Integral and Anchor QEA 2013) and are summarized in the RI Report, Section 5.6.6. RI Report Section 5.2.4.2.6 describes spatial patterns in tissue concentrations of $TEQ_{DF,M}$[1] relative to the waste impoundments. All of this information was consulted in preparing this Tissue SAP Addendum.

Observations and conclusions of the Remedial Investigation used to inform the DQOs for the 2016 tissue sampling include:

- Dioxin and furan bioaccumulation is regulated largely by physiological mechanisms such as limitations on rates of uptake across gill and gut membranes imparted by the size of molecules (Opperhuizen and Sijm 1990), metabolism, and excretion. Also, fish

[1] Toxic equivalent concentration calculated for dioxin and furan congeners using toxicity equivalency factors for mammals.

and invertebrates continuously metabolize and excrete dioxins and furans, making tissue concentrations of dioxins and furans dynamic and difficult to predict using simplistic models.

- The number and variety of factors affecting bioaccumulation of dioxins and furans into biota result in limitations on the utility of biological tissue in identifying and describing sources of dioxins and furans. The specific source of any given congener or of the dioxin and furan mixture in tissue cannot be identified with confidence (Integral 2010b). Specification of the source or sources of dioxin and furans in catfish fish and crab tissue is not possible because these species are mobile and their movements are not well described.
- Concentrations of dioxins and furans in fish and crab are not clearly a function of position in the food chain, but are accumulated more as a function of proximity to sediment in which dioxins and furans are present. In a 2009 report *National Study of Chemical Residues in Lake Fish Tissue* (USEPA 2009b), USEPA found that benthic fish species generally had higher concentrations of dioxins and furans than predatory fish species.
- Consistent with this general observation, the spatial patterns of $TEQ_{DF,M}$ concentrations in clams (common Rangia, *Rangia cuneata*) and in the Gulf killifish (*Fundulus grandis*) collected within USEPA's Preliminary Site Perimeter prior to implementation of the TCRA (Figure 2) appear to be closely related to proximity to the impoundments north of I-10 (Figure 3).[2] Both of these species have limited spatial movements. For both species, the maximum $TEQ_{DF,M}$ concentrations (and the most variable) occurred at Transect 3, directly adjacent to the wastes in the impoundments north of I-10. The second highest $TEQ_{DF,M}$ concentrations for both species were at Transect 5, adjacent to the upland sand separation area. This was not observed for blue crab (*Callinectes sapidus*) and hardhead catfish (*Arius felis*) (see Tables 5-13, 5-14, 5-15 and 5-16 of the RI Report)
- The spatial pattern observed for both clams and Gulf killifish is consistent with observations of USEPA (2009b) that concentrations of dioxins and furans in aquatic

[2] For the purposes of this illustration, $TEQ_{DF,M}$ concentrations in this figure were calculated with ND = 0, because of the large number of congeners that were not detected in tissue, particularly in the Gulf killifish.

species are best understood as a function of proximity to sediments in which dioxins and furans are present, and not position on the food chain.

In addition to the information on spatial patterns of bioaccumulation documented in the RI Report and summarized above, the edible blue crab and hardhead catfish fillet samples collected from within the San Jacinto estuary and downstream of the Fred Hartmann Bridge were considered to inform the selection of species to be sampled in 2016. In October 2011, samples of edible crab and hardhead catfish fillet were collected within the San Jacinto estuary, downstream of the Fred Hartmann Bridge. These samples were collected to address data gaps, described by Integral and Anchor QEA (2011b). The range of concentrations of $TEQ_{DF,M}$ in these samples overlaps substantially with the range of the same tissue types collected from within USEPA's Preliminary Site Perimeter (Figure 4). This illustrates that hardhead catfish and blue crab are exposed to dioxins and furans across the San Jacinto estuary and the Galveston Bay area. Because catfish and blue crab are highly mobile and the locations and timing of their migrations are not well understood, and because there are other sources of dioxins in the San Jacinto estuary and Galveston Bay, these two species are not good indicators of exposure of fish to dioxins and furans that could have originated from within USEPA's Preliminary Site Perimeter.

DATA QUALITY OBJECTIVES

This section provides a summary of the DQOs for the sampling of Gulf killifish, inclusive of the objective of the task, analytical approach, sampling locations and schedule.

Statement of the Problem

According to an email communication from USEPA to David Keith on August 6, 2015, and a meeting between Respondents and USEPA in March 2016, the problem to be addressed by additional tissue data is:

- Study Element 3. Fate and Transport. Verification that the armored cap is preventing releases of dioxin and furans from the paper mill waste to the fish that inhabit shoreline areas proximal to the capped area is necessary to support selection of a final remedy for the waste impoundments north of I-10.

Gulf killifish were selected for sampling to address this problem, as described below. However, given the uncertainties in the CSM, the tissue data to be collected according to this Tissue SAP Addendum may not definitively resolve the problem related to Study Element 3.

Sampling Objective

The objective of sampling fish tissue to address the stated problem is to collect and analyze composites of a minimum of 10 fish and at least 15 g of whole Gulf killifish at each of a subset of the transects sampled in 2010 (Figure 5). Four transects will be sampled: Transects 2, 3, 4 and 5 (Figure 5); two composites of 10 fish comprising at least 15 g of Gulf killifish will be collected at each transect location, for a total of eight composite samples.

The transects selected for sampling are those within USEPA's Preliminary Site Perimeter that represent the range of expected Gulf killifish tissue concentrations both adjacent to and away from the TCRA cap. Samples will be collected in each of these areas consistent with methods and locations sampled in 2010 to enable direct comparisons within and between the selected locations.

The objective of sampling is to characterize $TEQ_{DF,M}$ concentrations in Gulf killifish tissues at these selected locations within USEPA's Preliminary Site Perimeter relative to concentrations in the same types of samples collected in 2010. Data will be analyzed to evaluate whether differences between past and present tissue concentrations of $TEQ_{DF,M}$ are greater at Transect 3 than at other transects, and to evaluate whether there has been an overall reduction in tissue concentrations of $TEQ_{DF,M}$ at Transect 3.

Clams were not selected as a target species for 2016 because the presence of the armored cap throughout the intertidal zone at the location of Transect 3 likely makes that area uninhabitable by clams. Catfish and blue crab were not selected for sampling in 2016 because they are a poor indicator of local conditions, and would not inform the uncertainty addressed in the problem statement.

Tissue sampling and analyses described in this draft addendum will be conducted in full compliance with the Tissue SAP (Integral 2010a) and incorporates that document by reference. The Tissue SAP describes the means to achieve all QA/QC requirements and

documentation articulated by USEPA's guidance for preparation of quality assurance project plans and field sampling plans (FSPs) (USEPA 2001, 2002); these specifications will be applied to the collection, analysis, QA review, data management, validation, and reporting of the information generated as described in this draft Addendum.

Sample Collection and Processing

Sampling methods for capture of Gulf killifish are described in Section 2.2.5 of Appendix A of the Tissue SAP, the FSP (Integral 2010). Gulf killifish processing steps are described in Section 2.2.10.2 of the 2010 FSP. Because of the difference in seasonal timing of sampling to be conducted in 2016 from that in 2010, fish sample processing will target the same size fish as those collected in 2010, which ranged in length from 50 mm to about 90 mm.

Table 1 provides a checklist of samples for use in the field during sampling. It is analogous to Table A-3 in Appendix A of the Tissue SAP (Integral 2010a).

Sample Processing in the Field: Gulf killifish tissue samples will be processed in a mobile field laboratory, as they were during the initial tissue sampling event conducted in October 2010 (Integral 2011). The field laboratory will be used to 1) verify that each organism is the correct species, 2) measure and record fish length and weight, 3) photograph each fish, and 4) package and label samples.

Sample Processing and Analysis at the Laboratory: Tissue samples will be homogenized at ALS Houston and resulting composites will be analyzed for the seventeen 2,3,7,8-substituted dioxins and furans, percent lipids, and percent moisture. The laboratory will generate a homogenization equipment rinsate blank for the equipment used for sample preparation and homogenization. Sample containers, preservation requirements, and holding times are presented in Table 2. Laboratory methods are presented in Table 3 and analyte lists and expected method detection limits and method reporting limits are presented in Table 4. Updated laboratory standard operating procedures (SOPs) are presented in Appendix A.

Data Analysis: Concentrations of each dioxin and furan congener in the tissue samples will be entered into the project database and validated. $TEQ_{DF,M}$ will be calculated from these data, consistent with the project data management plan (Anchor QEA and Integral 2010).

Concentrations of $TEQ_{DF,M}$ for Gulf killifish collected in 2016 will be compared with concentrations in those collected from the same locations in 2010. The spatial patterns of the of the dioxin and furans and of $TEQ_{DF,M}$ concentrations will be qualitatively compared to those from 2010 using graphics like Figure 3 and using a map.

Boundaries of the Study

The sampling program will be conducted four transects sampled within USEPA's Preliminary Site Perimeter (Figure 1). Sampling will be completed within 1 week following initiation.

Concentrations of dioxins and furans in fish tissue fluctuate depending on breeding status due to fluctuations in fish body weight and tissue lipid content. Generally, Gulf killifish spawn multiple times between March and October. In Trinity Bay, which is near and to the south of USEPA's Preliminary Site Perimeter, spawning takes place in August and September. Past sampling events for fish tissue were conducted in October. Due to the currently anticipated project schedule, sampling for Gulf killifish in 2016 will be conducted in April.

The difference in the timing of sampling in 2016 from timing of sampling in 2010 presents some uncertainty, because the fish collected in 2016 will likely be in a different phase of their reproductive cycle than those collected in 2010. The specific effect of this timing difference is unknown.

Timing of Sampling and Reporting

Sampling will be conducted following approval of this SAP Addendum. Commencement of fish tissue sampling is expected the week of April 25, 2016. If sampling is complete by April 30, 2016, validated analytical results are expected to be available and loaded to the project database by July 1, 2016.

Concentrations of dioxins and furans in fish tissue fluctuate depending on breeding status as a result of fluctuations in fish body weight and tissue lipid content. Generally, Gulf killifish spawn multiple times between March and October. In Trinity Bay, which is near and to the south of USEPA's Preliminary Site Perimeter, spawning takes place in August and September. Past sampling events for fish tissue were conducted in October. Due to the

currently anticipated project schedule, sampling for Gulf killifish in 2016 will be conducted in April.

The difference in the timing of sampling in 2016 from timing of sampling in 2010 presents some uncertainty, because the fish collected in 2016 will likely be in a different phase of their reproductive cycle than those collected in 2010. The specific effect of this timing difference is unknown.

Sampling personnel will comply with the overall Health and Safety Plan (HASP) (Anchor QEA 2009). An update to Addendum 2 to the overall HASP provided in Appendix A of the Tissue SAP (Integral 2010a) will be used for this sampling effort; all other specifications for health and safety of this field program are provided in Addendum 2 to the overall HASP, which is in Appendix A of the Tissue SAP. The update to HASP Addendum 2 is provided in Appendix B.

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USEPA, 2010c. Administrative Settlement Agreement and Order on Consent for Removal Action. U.S EPA Region 6 CERCLA Docket. No. 06-12-10. In the matter of: San Jacinto River Waste Pits Superfund Site Pasadena, Texas. International Paper Company, Inc. & McGinnes Industrial Maintenance Corporation, respondents.

TABLES

Table 1
Field Sample Collection Matrix

Tissue Sampling Location	Sample ID	Tissue Type	Sample Number	Tag Number	Target Species	Composite Sample Type	Minimum No. in Composite [d]	Minimum Target Tissue Mass Required [d]	Sample Group	Tissue Samples PCDD/F, percent moisture, and lipids Field: Fish will be foil wrapped and double bagged; Lab: 4 oz. WMG for homogenate [b] 4±2°C in field/frozen (-20°C) after field processing, during shipment, and for laboratory storage and laboratory transfer [b]	Blank Filter Wipes [a] PCDD/F 4 oz. WMG [c] 4±2°C
☐ SJTTR2	SJTTR2-SF3	Small Fish (50-90 mm) [c]	TS0181	TG0300	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR2	SJTTR2-SF4	Small Fish (50-90 mm) [c]	TS0182	TG0301	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR3	SJTTR3-SF3	Small Fish (50-90 mm) [c]	TS0183	TG0302	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR3	SJTTR3-SF4	Small Fish (50-90 mm) [c]	TS0184	TG0303	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR4	SJTTR4-SF3	Small Fish (50-90 mm) [c]	TS0185	TG0304	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR4	SJTTR4-SF4	Small Fish (50-90 mm) [c]	TS0186	TG0305	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR5	SJTTR5-SF3	Small Fish (50-90 mm) [c]	TS0187	TG0306	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ SJTTR5	SJTTR5-SF4	Small Fish (50-90 mm) [c]	TS0188	TG0307	Gulf Killifish	Whole body	10 Fish	15 g	Within Site Perimeter	☐	
☐ FW Blank	SJFW-912	NA	FW0012	TG0308	NA	Equipment Filter Wipe	NA	NA	NA		☐
☐ Filter Blank	SJFB-913	NA	FB0013	TG0309	NA	Filter Blank	NA	NA	NA		☐

Notes

NA = not applicable

PCDD/F = polychlorinated dibenzo-*p* -dioxin and polychlorinated dibenzofuran

WMG = wide mouth glass

a - Whatman filter papers will be used for organic blanks. Equipment filter wipe blanks will be collected by wiping the tweezers and aluminum foil used for weighing and measuring the fish sample.

b - The size and number of containers may be modified by the analytical laboratory.

c - The target length provided in this table is an estimate and will be modified during the sampling event, depending upon the actual fish size class encountered in the field.

d - Triple the amount of target tissue mass will be required for one sample for laboratory quality control samples a (i.e., 45 g).

Table 2
Sample Containers, Preservation, and Holding Time Requirements

Parameter	Container [a, b]		Laboratory	Preservation	Holding Time	Sample Size
	Type	Size				
Tissue						
Dioxins/furans, percent lipids, and percent moisture	WMG	4 oz.	ALS-Houston	Deep frozen (-20°C)	1 year	15 g
Equipment Filter Wipe Blanks (generated in the field) [c]						
Dioxins/furans	WMG	4 oz.	ALS-Houston	4±2°C	1 year/1 year [d]	1 wipe
Tissue Homogenization Rinsate Blanks (generated by the laboratory) [e]						
Dioxins/furans	AG	500 mL	ALS-Houston	4±2°C	1 year	500 mL

Notes

AG - amber glass
WMG = wide mouth glass

a - The containers listed for tissues reflect the jars necessary for storage of homogenized tissue samples at the testing laboratory. Prior to homogenization (i.e., in the field), samples will be wrapped in foil and double-bagged in resealable plastic bags. All tissues will be processed by ALS Houston prior to analysis.
b - The size and number of containers may be modified by the analytical laboratory.
c - Whatman filter papers will be used for organic blanks and Ghost wipes will be used for metals/mercury blanks.
d - Holding time for samples prior to extraction/holding time for extracts.
e - Homogenization rinsate blanks will be generated by the laboratory from the equipment used for sample preparation and homogenization.

Table 3
Laboratory Methods for Tissue Samples

Parameter	Laboratory	Sample Preparation		Quantitative Analysis	
		Protocol	Procedure	Protocol	Procedure
Conventionals					
Percent moisture	ALS-Houston	--	--	ALS SOP	Balance/gravimetric
Percent lipids	ALS-Houston	EPA 1613B	Soxhlet extraction [a]	ALS SOP	Balance/gravimetric
Organics					
Dioxins/furans	ALS-Houston	EPA 1613B	Soxhlet extraction	EPA 1613B	HRGC/HRMS
			Acid cleanup		

Notes

EPA = U.S. Environmental Protection Agency

HRGC/HRMS = high-resolution gas chromatography/high-resolution mass spectrometry

SOP = standard operating procedure

a - A portion of the dioxin/furan extract will be used for lipids determination.

Table 4
Analytes, Analytical Concentration Goals, Method Reporting Limits, and Method Detection Limits for Tissue Samples

Analyte	CAS Number	Method Reporting Limit	Method Detection Limit [a]
Conventionals			
Percent moisture (percent)	--	NA	0.01
Percent lipids (percent)	--	NA	0.1
Organics			
Dioxins/furans (ng/kg wet weight)			
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	0.5	0.0652
1,2,3,7,8-Pentachlorodibenzo-*p* -dioxin	40321-76-4	2.5	0.0203
1,2,3,4,7,8-Hexachlorodibenzo-*p* -dioxin	39227-28-6	2.5	0.0181
1,2,3,6,7,8-Hexachlorodibenzo-*p* -dioxin	57653-85-7	2.5	0.0204
1,2,3,7,8,9-Hexachlorodibenzo-*p* -dioxin	19408-74-3	2.5	0.0186
1,2,3,4,6,7,8-Heptachlorodibenzo-*p* -dioxin	35822-46-9	2.5	0.0149
Octachlorodibenzo-*p* -dioxin	3268-87-9	5	0.0333
2,3,7,8-Tetrachlorodibenzo-*p* -dioxin	1746-01-6	0.5	0.0374
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	2.5	0.0330
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	2.5	0.0322
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.5	0.101
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.5	0.00928
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	2.5	0.0131
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	2.5	0.0101
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	2.5	0.0136
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	2.5	0.0227
Octachlorodibenzofuran	39001-02-0	5	0.0710
Total tetrachlorinated dioxins	41903-57-5	NA	NA
Total pentachlorinated dioxins	36088-22-9	NA	NA
Total hexachlorinated dioxins	34465-46-8	NA	NA
Total heptachlorinated dioxins	37871-00-4	NA	NA
Total tetrachlorinated furans	30402-14-3	NA	NA
Total pentachlorinated furans	30402-15-4	NA	NA
Total hexachlorinated furans	55684-94-1	NA	NA
Total heptachlorinated furans	38998-75-3	NA	NA

Notes

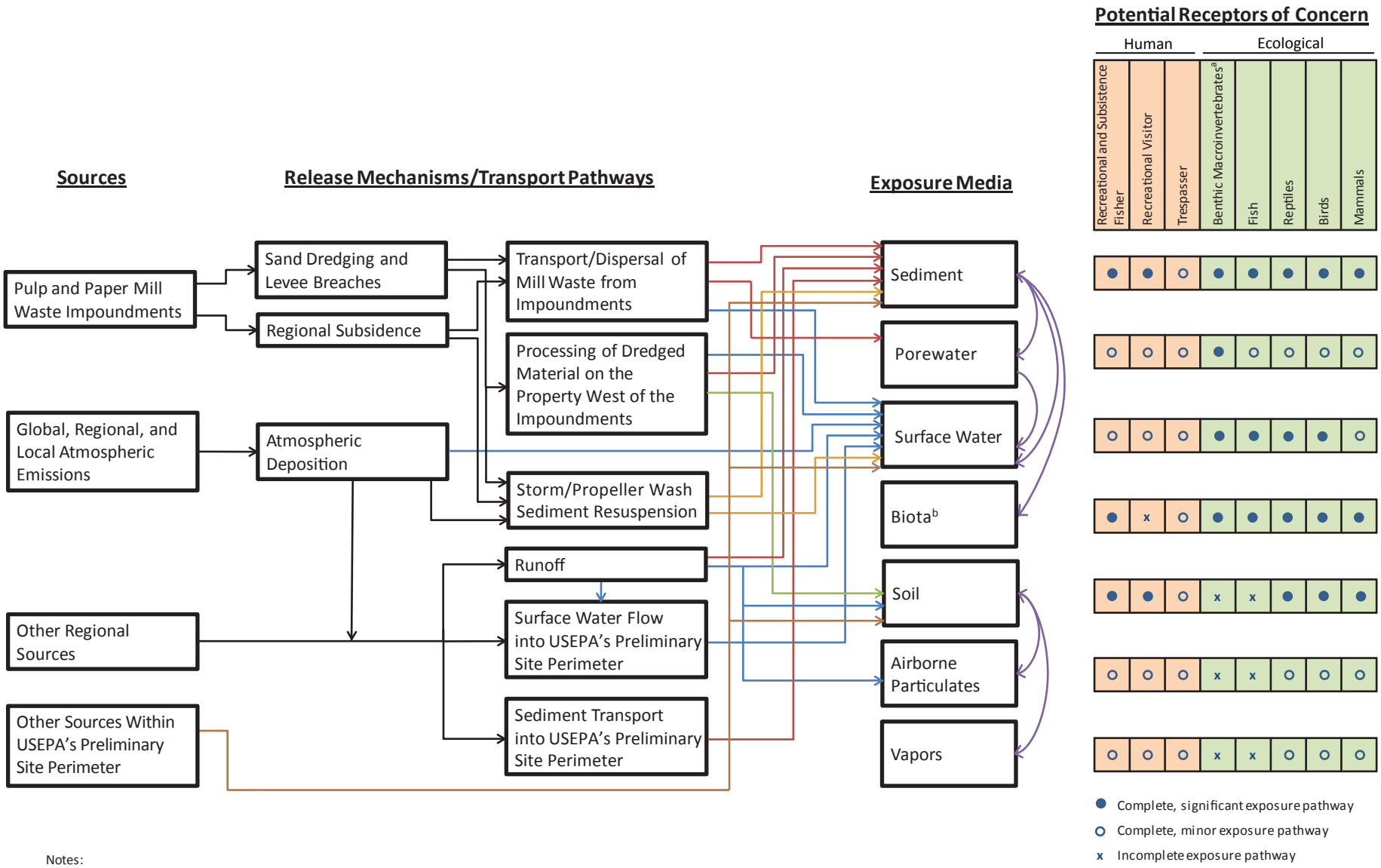
-- = none

CAS = Chemical Abstract Service

NA = not applicable

a - Average estimated detection limits are listed for dioxin/furans and PCB congeners.

FIGURES



Notes:

Other regional sources include industrial effluents, publicly owned treatment works, and stormwater.

Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.

[a]Benthic macroinvertebrates include crabs and other crustaceans and shellfish that may be consumed by all hypothetical receptors, as well as polychaetes and other infauna consumed by fish, other marine life, birds and mammals.

[b]Biota assumed to be consumed by hypothetical human receptors are expected to be fish and shellfish.

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Figure 1
Conceptual Site Model Pathways for the Area North of I-10 and Aquatic Environment
Tissue SAP Addendum 2
SJRWP Superfund/MIMC and IPC

SAN JACINTO RIVER

SJFCA3

Upland Sand Separation Area[a]

SJFCA2

SJTTR6

SJTTR5

SJTTR4

SJTTR3

10

SJTTR2

SJTTR1

SJFCA1

P:\Projects\C643_SJWaste_IPC\Production_MXDs\SAP_2015\Figure_2_fish_collection_tissue_sampling.mxd 3/21/2016 2:28:30 PM

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USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

Approximate TCRA Footprint

Clams and Small Fish

Small Fish

Clams

Large Fish and Blue Crab Fish Collection Areas

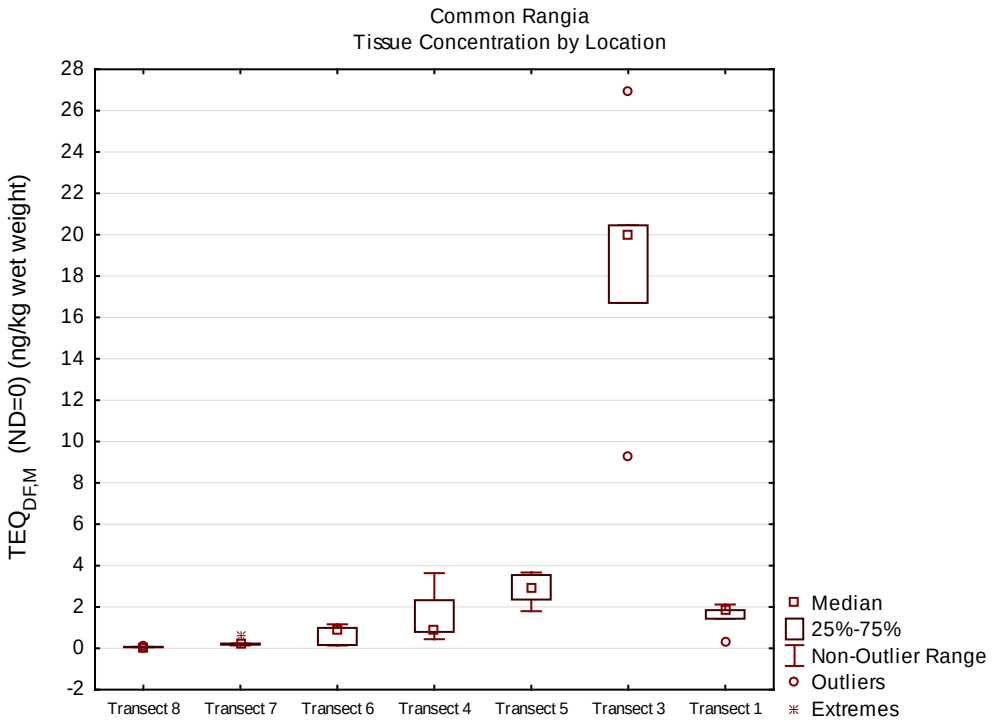
0 800

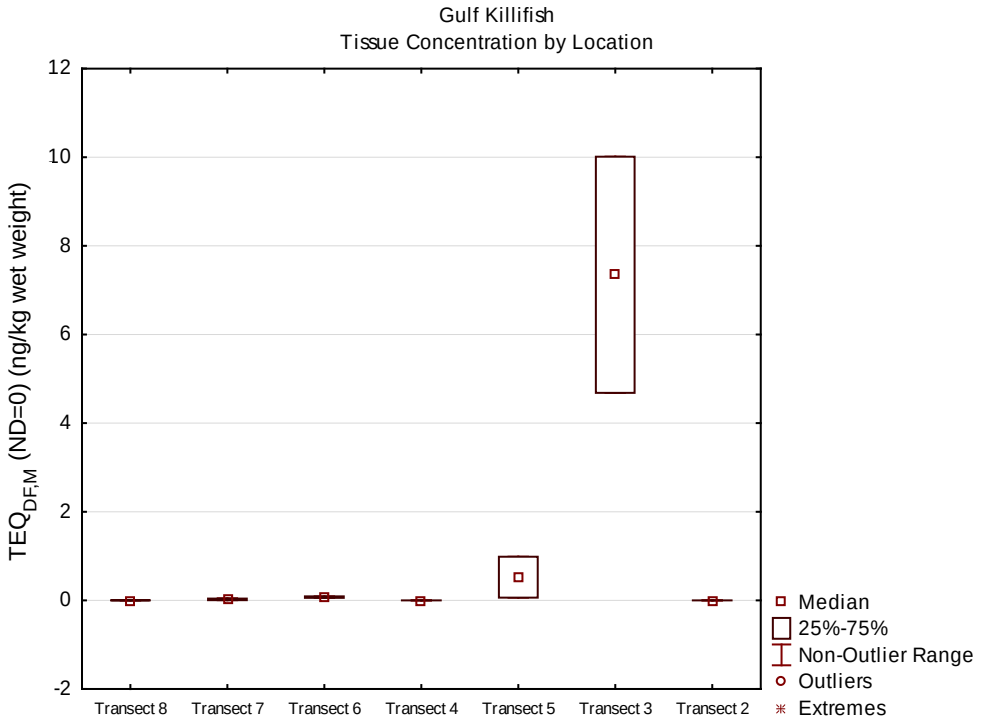
Scale in Feet

[a] Designation of the sand separation area is intended to be a general reference to areas in which such activities are believed to have taken place based on visual observations of aerial photography from 1998 through 2002.

FEATURE SOURCES:
Aerial Imagery: 0.5-meter January 2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNIS

Figure 2
Pre-TCRA Baseline Fish Collection Areas and Tissue SamplingTransects within USEPA's Preliminary Site Perimeter
SJRWP Tissue SAP Addendum 2
SJRWP Superfund/MIMC and IPC





Notes:

Transects are listed upstream to downstream, left to right.

Transect 1 has only bivalve data, while Transect 2 has only killifish data. These transects are located within close proximity to each other in fish collection area (FCA) 1, as shown in Figure 2.

$TEQ_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using toxicity equivalency factors for mammals

Figure 3

$TEQ_{DF,M}$ in Clam and Gulf Killifish Tissues by Location

Tissue SAP Addendum 2

SJRWP Superfund/MIMC and IPC

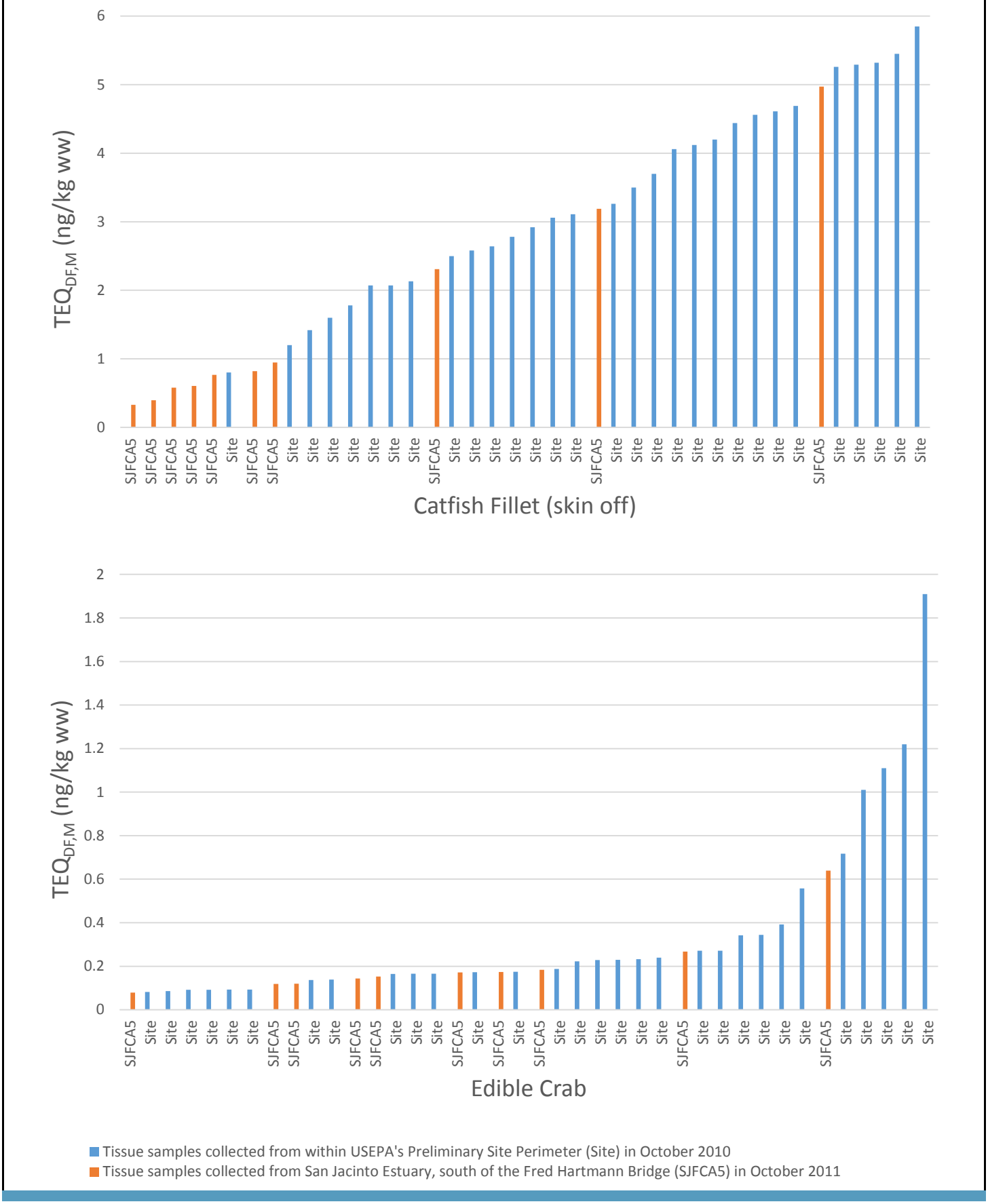


Figure 4
Concentrations of $TEQ_{DF,M}$ in Edible Catfish and Crab Tissue
SJRWP Tissue SAP Addendum 2
SJRWP Superfund/MIMC and IPC

ANCHOR QEA

integral consulting inc

Preliminary Site Perimeter

Original (1966) Perimeter of the Impoundments

Small Fish

0 800

Scale in Feet

[a] Designation of the sand separation area is intended to be a general reference to areas in which such activities are believed to have taken place based on visual observations of aerial photography from 1998 through 2002.

FEATURE SOURCES:
Aerial Imagery: USGS

Figure 5
Tissue Sampling Locations
Within the Preliminary Site Perimeter
SJRWP Tissue SAP Addendum 2
SJRWP Superfund/MIMC and IPC

APPENDIX A
LABORATORY STANDARD OPERATING PROCEDURES